## Space Weather Technical Forecast

Issued on Sunday 26 January 2025 at 00:32 Local

**This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

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**Space Weather Forecast Headline: Chance of G1 geomagnetic storms Day 1 (26 Jan), ongoing chance of isolated M-class flares.**

**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity:** Activity has been at Low levels, with several C-class flares in the last 24 hours.

There are currently eight sunspot regions visible on the Earth-facing disc. The largest, most active and nominally most complex region remains AR3961 near the southwestern limb. This group has shown fading in its central and trailing portions, where the weak delta spot has previously been seen, but this is likely due to the difficult viewing angle near the limb. AR3967, whilst still very small, has shown some spot emergence with a north-south aligned magnetic structure which could be more unstable than otherwise indicated. Other regions are relatively small at the present time, however looping on the east limb suggests the potential for more region(s) to rotate onto the disc.

No Earth-directed CMEs have been seen in the last 24 hours.

**Solar Wind / Geomagnetic Activity:** The solar wind, as measured by ACE at L1, showed a decline to background levels after a recent fast wind. Wind speeds were at slightly elevated levels, around 450km/s, becoming background near 360 km/s. The density was below average. The IMF was weak, at 5nT or below, with the north-south component varying weakly between +/-4nT. The phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-1).

**Energetic Particles / Solar Radiation:** High energy proton flux at GOES18 was at background levels.

High energy electron flux (greater than 2MeV) at GOES16 was Moderate, with a diurnal peak of 902pfu seen at 25/1555 UTC. The associated 24-hour fluence persisted below the Active threshold, reaching 3.08e7 integrated pfu at 26/0000UTC.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** Low to Moderate solar activity is expected with a chance of isolated M-class flares and a slight chance of X-class flares.

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**Solar Wind / Geomagnetic Activity:** A potential CME arrival was expected around 25/1800UTC. Whilst it is later than previously anticipated, an arrival from this feature cannot be ruled out during the first half of Day 1 (26 Jan). A coronal hole looks to be emerging in the northwest quadrant of the disc, however any influence from this feature is likely to be limited.

Quiet to Unsettled activity (Kp 1-3) is likely, but with a chance of Active to G1/Minor Storm (Kp 4-5) intervals through Day 1 (26 Jan) should we see any CME arrival, with a slight chance of G2-G3/Moderate-Strong Storm (Kp 6-7) intervals.

**Energetic Particles / Solar Radiation:** There is a slight chance of enhancements exceeding the S1/Minor Radiation Storm threshold, should any larger flares occur from the western hemisphere.

GOES16 high energy electron flux is likely to show a gradual decline, but with some uncertainty from any CME arrival. The corresponding 24-hour fluence is expected to remain below the Active threshold on a declining trend.

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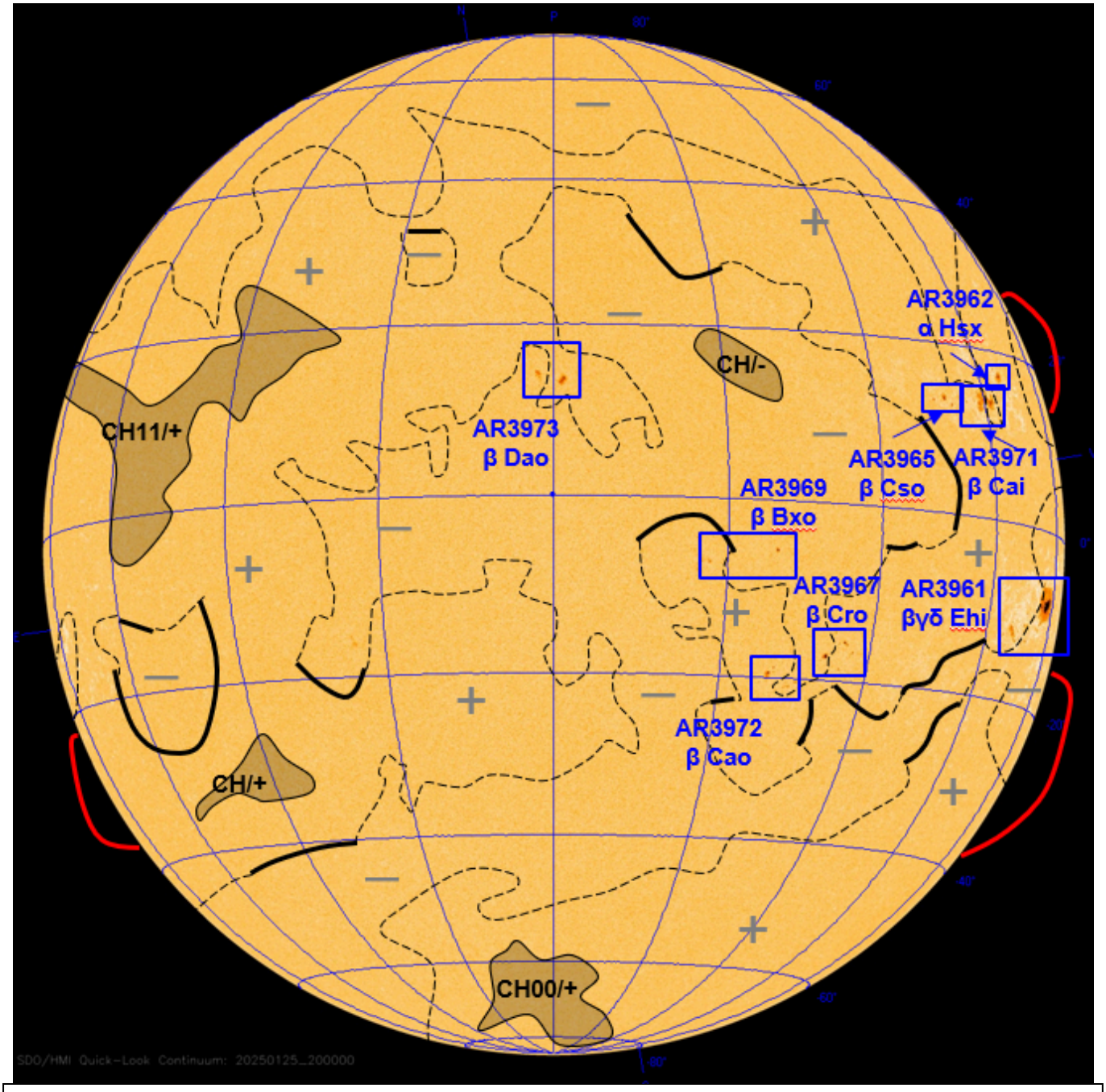
**Figure 1: Solar synoptic map, valid 25/2000 UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms

Two CMEs have been featuring in the forecast - firstly that from an M-flare from AR3967 on the 21 January, and secondly a filament and M1.3-flare related event near AR3961 from 22/1108UTC. The first is thought to have missed Earth. The second was expected around 25/1800UTC but whilst it is later than previously anticipated, an arrival from the feature cannot be ruled out during the first half of Day 1 (26 Jan), given that it showed a full halo shock in coronagraph imagery.

Whilst a coronal hole looks to be emerging in the northwest quadrant of the disc, it is currently small and well north of the solar equator. With Earth now well to the south of the solar equator, any influence from this feature is expected to be limited.

Quiet to Unsettled activity (Kp 1-3) is expected in general, but with a chance of Active to G1/Minor Storm (Kp 4-5) intervals through Day 1 (26 Jan) if we see any CME arrival, with a slight chance of G2-G3/Moderate-Strong Storm (Kp 6-7) intervals, should the CME be a dense feature (which is possible given the filament origin).

| Geomagnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 30 | 5 | 5 | 5 |
| Strong | G3 | No | 5 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

### Geomagnetic Activity - Earthbound Coronal Mass Ejections

| Date/time 21.5R⊙ (UTC) | Halo: Full or Partial | Source | Source Location | Estimated Speed (km/s) | Estimated Arrival Time (UTC) | Comments |
|---|---|---|---|---|---|---|
| 22/1727 | Full | AR3961 | S Centre | 591 | 25/1800 | CME is later than originally anticipated, but arrival during early Day 1 (26 Jan) cannot be ruled out. |

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**Figure 2: MOSWOC Enlil, showing the potential CME arrival and wind speeds near background levels.**

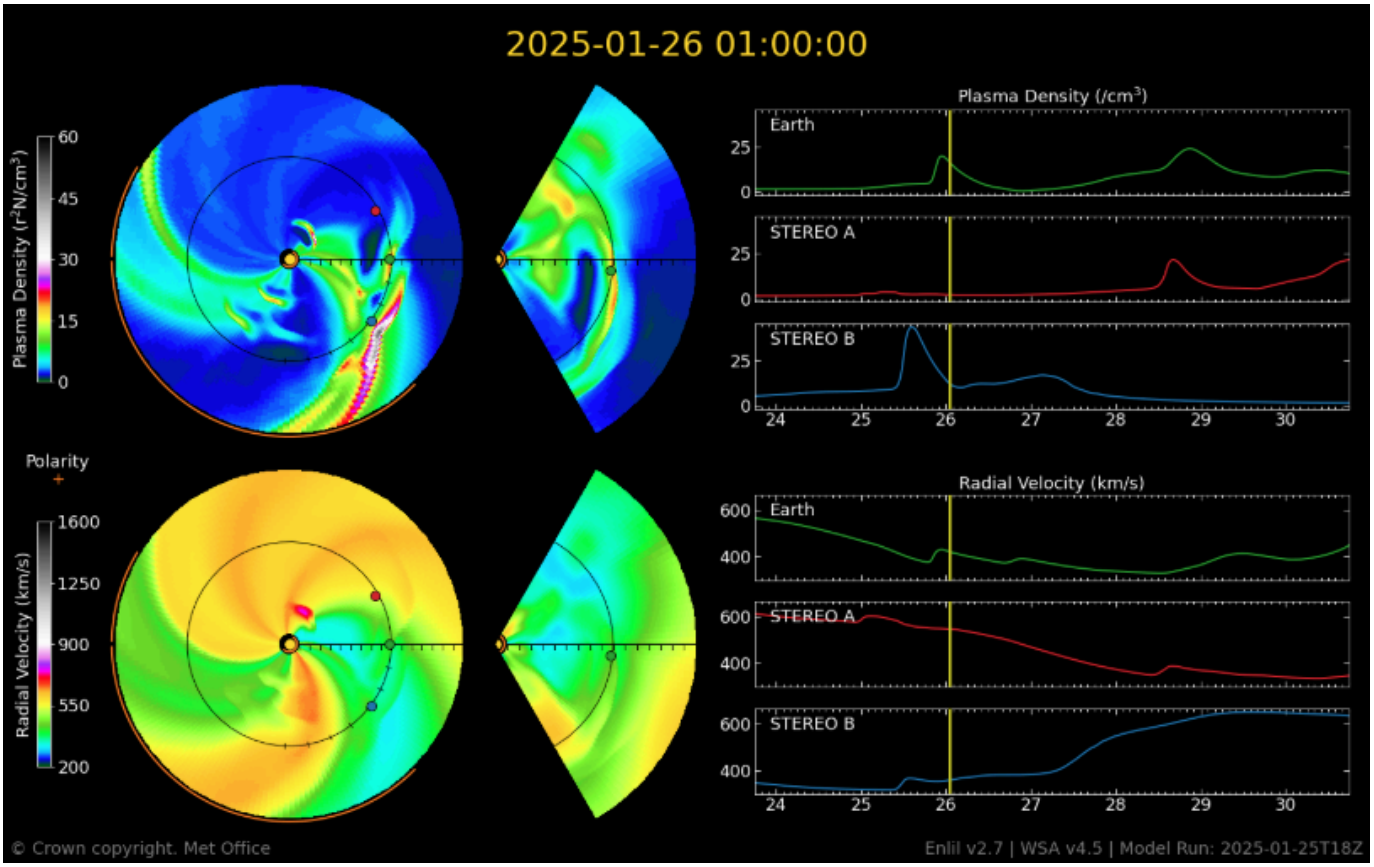




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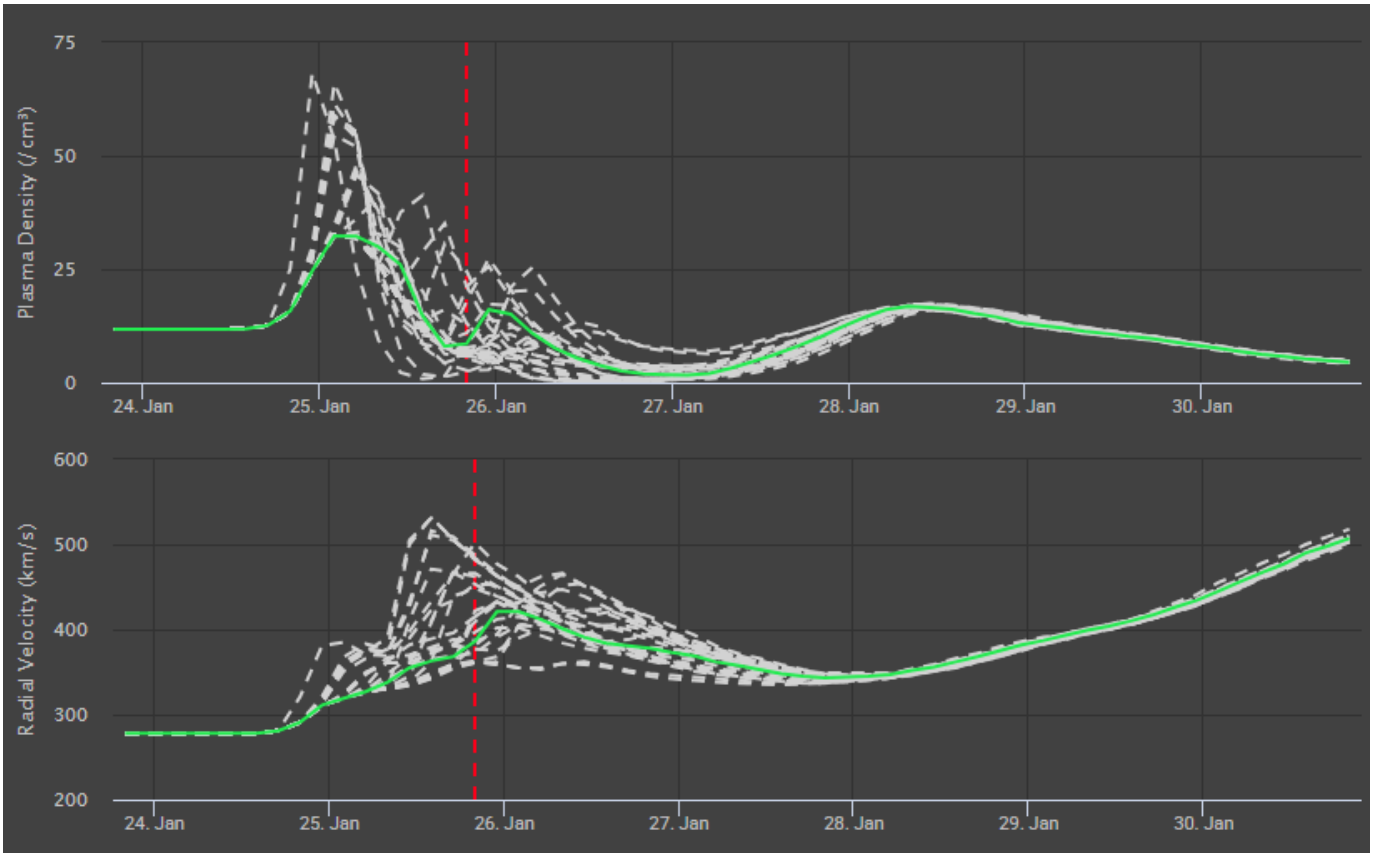
**Figure 3: Enlil ensemble, showing the potential CME arrival.**



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## Radio Blackouts - X-Ray Flares

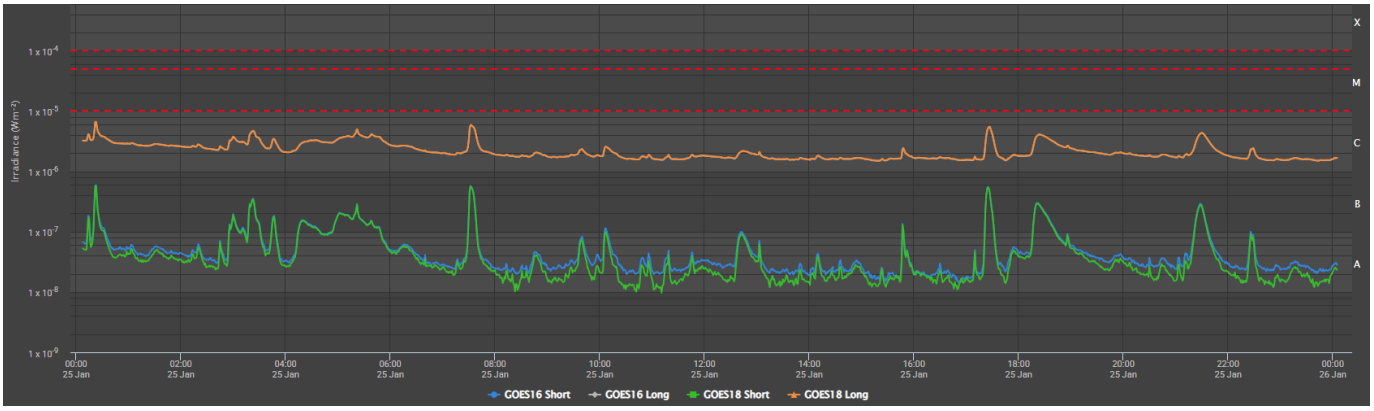
There are currently eight sunspot regions visible on the Earth-facing disc. The largest, most active and nominally most complex region remains AR3961 near the southwestern limb. This group has shown fading in its central and trailing portions, where the weak delta spot has previously been seen, but this is likely due to the difficult viewing angle near the limb. The current classification is maintained in the absence of other information about this region. It is due to rotate off the disc early on Day 2 (27 Jan), with its influence on the forecast declining over the following 24 hours. AR3967, whilst still very small, has shown some spot emergence with a north-south aligned magnetic structure which could be more unstable than otherwise indicated. Other regions are relatively small at the present time, however looping on the east limb suggests the potential for more region(s) to rotate onto the disc.

This means that trends in the coming four-day forecast period will rely on a trade-off between the departure of AR3961 and any east limb arrivals, with some suggestion of activity here given a series of CMEs emitted from over the east limb in recent days.

Overall, the daily flare risk is reduced a little after AR3961 rotates away from the west limb, given uncertainty about the nature of oncoming regions. This may be revised upwards once any new regions become visible in the eastern hemisphere. Low to Moderate solar activity is expected with a chance of isolated M-class flares and a slight chance of X-class flares.

| X-Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 (M Class) | No | 50 | 50 | 40 | 40 |
| Very Active | R3-R5 (X Class) | No | 10 | 10 | 5 | 5 |

**Figure 4: X-ray flux at GOES16 and 18, showing Low activity in the last 24 hours.**

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## Solar Radiation Storms (High Energy Protons)

Proton flux is currently at background levels, and is most likely to stay that way. However, there is a slight chance of it rising above the S1/Minor Radiation Storm threshold in the coming days, mainly due to AR3961 which is approaching the western limb. This region will have rotated well away from the west limb by Day 4 (29 Jan) so this risk declines towards the end of the period.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}sr^{-1}s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 15 | 15 | 10 | 5 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

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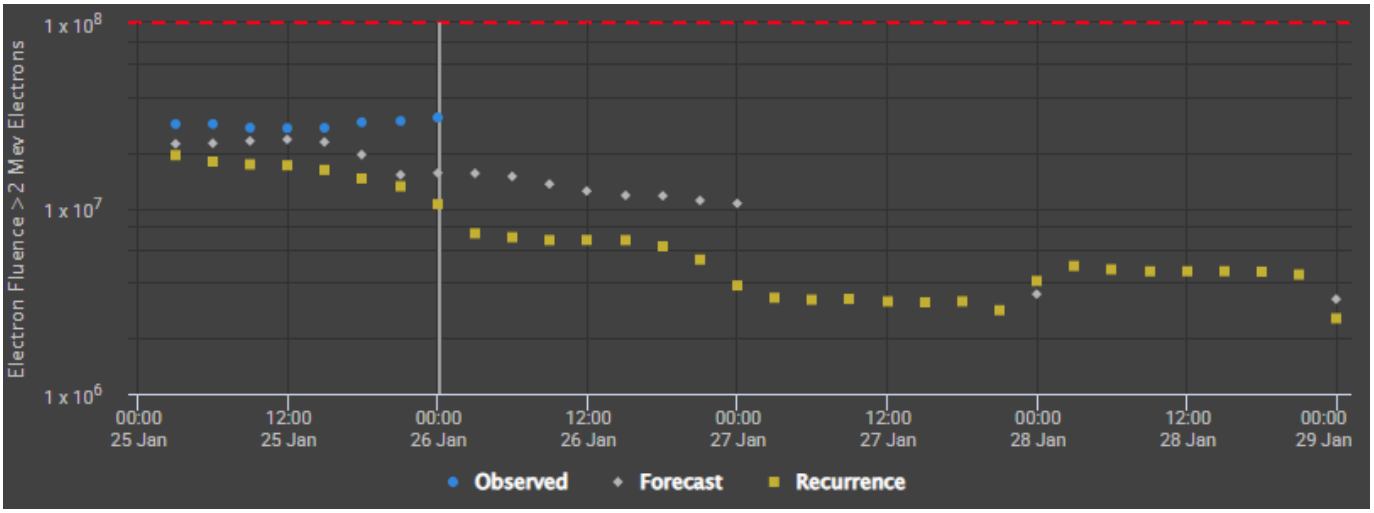
## High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has been mostly at moderate levels in the last couple of days, after previous diurnally high peaks. This has arisen after the connection to CH09/-, with this feature now lying over the western limb and wind speeds having returned to background levels. In the absence of further CME or HSS activity, a gradual decline in flux levels is forecast. Any CME arrival on Day 1 (26 Jan) could produce a rapid decline in flux levels at GEO, potentially followed by a rise later in the period depending on the activity associated with the CME. However, this feature may have missed Earth so confidence is low in this aspect.

The corresponding 24-hour fluence is expected to remain below the Active threshold, with a gradual downward trend. MOSWOC REFM is felt to be giving good guidance here, although the drop off could be much faster than REFM signals should the CME arrive in the coming hours.

| GEO Electron Environment | Level ($cm^{-2}sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Active | ≥ 2 MeV ≥ $1\times10^{8}$ | No | 5 | 1 | 1 | 1 |
| Very Active | ≥ 2 MeV ≥ $1\times10^{9}$ | No | 1 | 1 | 1 | 1 |

**Figure 5: MOSWOC REFM, showing a gradually declining trend which in the absence of a CME arrival seems reasonable. A faster decline is possible if the CME does arrive.**

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